Acceleration

- Issues
  - Energy spread to storage ring
  - Beam loading
  - Energy spread in arcs
  - Transverse acceptance
  - Transverse beam blowup
- Plans
  - 200 MHz racetrack RLA base design (JLab)
  - Analyze advantages, realism, of other ideas
    - Dogbone
    - 400 MHz
    - FFAG:
      - Isochronous
      - Non-isochronous

Generic Acceleration

- Parameter optimization
  - Plots versus turn number
    - ⋆ Arc cost linear in energy acceptance
    - ⋆ Arc costs increase with turns
    - ⋆ Linac costs decrease with turns
    - ⋆ Linac costs decrease with frequency

f	n	ΔE	η/B	Δx	Cost
MHz		MeV	T^{-1}	cm	
200	8	180	0.0474	2.9	185
200	6	273	0.0068	0.6	217
400	5	338	0.0137	1.5	203

  - Results
    - ⋆ Higher frequency better for fewer turns
    - ⋆ Energy spread strongly affects cost
    - ⋆ Reducing M_{56} increases energy spread, cost
    - ⋆ Momentum compaction too high for 200 MHz max η.
    - ⋆ Cost, energy spread increase with frequency for max η.
    - ⋆ More turns for optimum at lower frequency, energy spread
    - ⋆ Probable optimum: max η at lowest frequency
    - ⋆ Optimum not sharp
  - Task: understand arc cost dependence

Beam Loading

- Max at 400 MHz
  - Gradient sag: 9% (18% energy)
  - Energy oscillation amplitude: 18 MeV
    - Smooth approximation
    - Probably worse in real life, factor of 2?
- Beam loading non-issue
- Simulate for convincing results

Baseline Scheme Issues

- Maximize M_{56} for minimum energy spread
  - Try further off-crest?
- Transverse acceptance/blowup
  - Full nonlinear simulation in standard code (COSY?)
- Get dependence of arc cost on energy spread
  - Performance also
- Fast longitudinal rotation
- Full optimization

Alternative Scheme Plans

- Dogbone
  - Produce system design, compare to racetrack (Me, Carol)
- Isochronous FFAG
  - Multi-frequency scheme (loading, length): Palmer
  - Analyze, simulate for effects (me)
  - Arc design (Carol)
- Non-isochronous FFAG
  - Frequency shifting schemes
    - Ferrite (Zhao, ?): most promising?
    - Piezo
    - PIN diode

RF Power

- 200 MHz needed in two places
  - Acceleration
    - Small amount of power
    - 2 ms pulse length
  - Cooling
    - Vast majority of power
    - Major contributor to cost
    - 200 μs pulse length
  - Screams for pulse compression
    - Large cavity size
- Non-uniform pulse pattern
  - Average rep rate is 15 Hz
  - Local rep rate is 60 Hz
  - Source cost may be determined by local rep rate
    - Heating
    - Electron/ion clearing
- Consider various types
  - Klystrons (most likely)
  - Tetrodes (reliability)
  - Magnetrons (???)